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COMPETITIVE PRESSURES ON CHINA: FACTOR REWARDS MIGRATION

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Discussion paper

Competitive Pressures on China: Factor Rewards and Migration

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13 August 2001

Abstract

Our objective is to assess personal income under perfect competition, when factors are rewarded according to their productivities, and to contrast the ensuing distribution with the status quo. Competition will yield winners and losers, both in terms of factor claims and in terms of regions or provinces. Income differences will press people to migrate. To analyze this, we divide China into 30 input-output sectors and 27 provinces; we maximize domestic final demand, while preserving its proportions in each province, subject to material balances and factor constraints. The shadow prices to the constraints represent competitive commodity prices and factor rewards. Unskilled labor would stand to lose and, therefore, inequality would mount. The pressure on interprovincial migration would be enormous with 10 to 20% of the people on the road. The flipside is the great potential for improvement of the average standard of living.

Keywords: Competition; Income distribution; Migration; China

JEL-classification: D33, O15, J61, R23, O53

Competitive Pressures on China: Factor Rewards and Migration

1. Introduction

There is an unfortunate division of labor in the field of income distribution. Economists focus on the functional distribution of income, employing the concept of factor productivity. Statisticians focus on the personal distribution of income, particularly the measurement of income and inequality. Now we are interested in the question what competition would do to the distribution of income in China. This requires an integration of functional and personal income analyses, which seems novel.

Our objective is to assess personal income under perfectly competitive competition, where factors are rewarded according to their productivities, and to contrast the ensuing distribution with the status quo. For this we need two things. First, a general equilibrium model to determine the shadow prices of factor inputs (ten Raa and Mohnen, 2001). Second, detailed statistical information to assign factor inputs, such as different types of labor, to persons and families. In other words, we need the composition of personal income by source of income. Competition will reset the prices of the different types of labor and capital and, using the personal factor titles, a new personal income distribution will emerge.

Competition will yield winners and losers, both in terms of factor claims and in terms of regions or provinces. Income differences will press people to migrate. This mechanism will take some steam off the income inequality problem that comes with free markets in

China. We investigate it by running two scenarios. In the first specification of our general equilibrium model, mobility is limited to unskilled labor. In other words, we assume that people rather climb down the skill ladder than migrate and move only if they are pushed down to unskilled labor and face unemployment (with zero income under competition). In the second specification we extend free mobility to all levels of labor. Migration will mitigate provincial shortages and level out shadow prices for labor. The consequent inequality is expected to be less severe.

In this paper we focus on competitive income formation in China and summarize the entailing income levels and inequality. Detailed comparison of the competitive income inequality to the actual one, by urban-rural division, province, and social class, is left to the sequel paper (ten Raa and Pan, this issue).

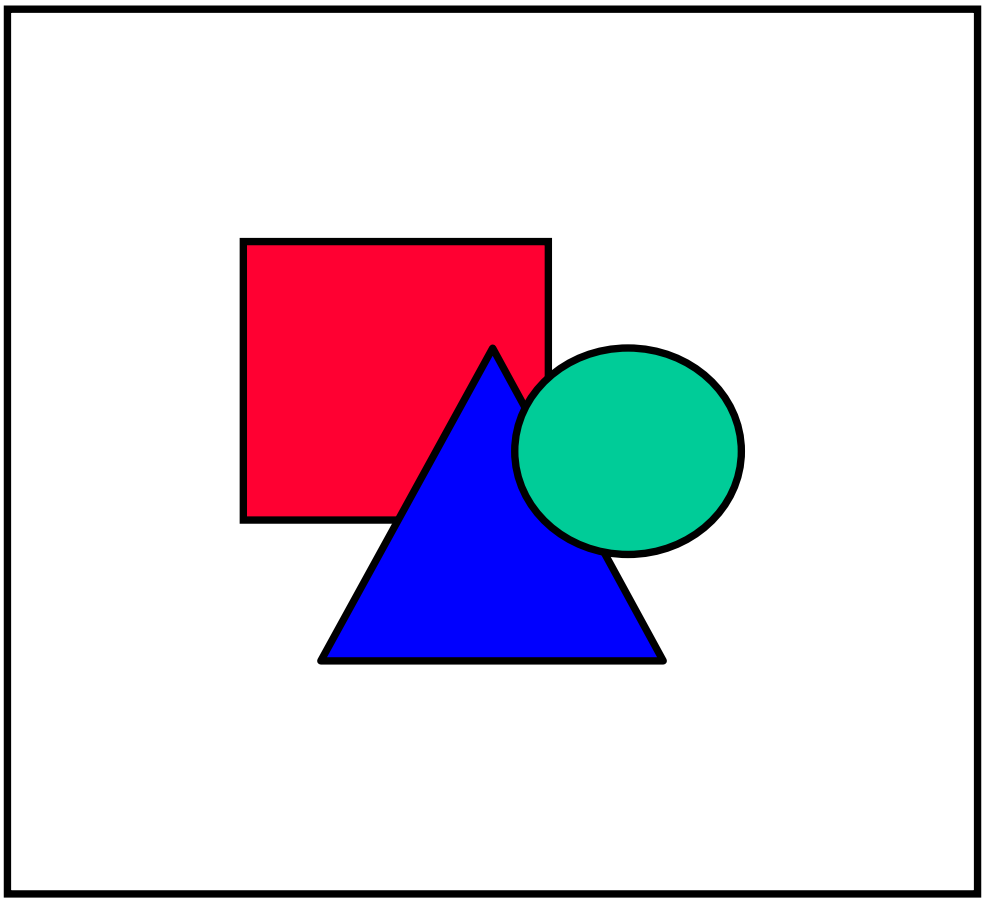
The remainder of this paper is structured as follows. Section 2 discusses the input-output model used to optimize the Chinese economy. Section 3 determines the supporting factor rewards and the consequent income statistics. Section 4 reveals the migration of labor across China's provinces. Section 5 concludes this paper.

2. The input-output model

We divide China into 30 input-output sectors and 27 provinces[1]. Figure 1 is a handy map[2]. Each province generates domestic final demand plus net exports, which are both 30-dimensional vectors. The provincial net exports vectors sum to the national net exports, because inter-provincial deliveries cancel out. National net exports remain fixed in our analysis, so any efficiency gain is brought about by the reallocation of production between provinces. We assume Leontief preferences; denote the domestic final demand proportions of province i by vector f^i (which we obtain by scaling the domestic final demand vector down to unity). The assumptions of the first and second

welfare theorems will be fulfilled, so we may determine the competitive allocation by maximizing the standard of living. The conflict of interest between provinces is handled in Negishi (1960) style, as follows.

Figure 1. Location of Chinese provinces



We let each province generate a domestic final demand vector with the same proportions, namely $f^i d_i D$, where scalar D represents the national domestic final use and d_i a provincial share. If we substitute observed values for D and d_i, we obviously obtain a feasible point. Given any list of d_i's (using the observed provincial shares as initial values), we maximize D. In short, we maximize domestic final demand, while preserving its proportions in each province, and given the provincial shares. The linear program described in Appendix 1 maximizes D subject to material balances and factor constraints. The shadow prices to the constraints represent competitive commodity

prices and factor rewards, respectively. The material balances, capital constraints, and unskilled labor constraints are at the national level, presuming free trade and mobility of capital and workers, at least of those who are threatened to loose income. The other labor constraints are either province specific or also pooled across China, depending on the scenario.

The linear program determines a gross output vector for each province. Subtraction of intermediate demand (as determined by the input-output matrix) and domestic final demand ($f^i d_i D$) yields the competitive net exports vector. Valuation by the competitive commodity prices yields the balance of payments of province *i*. If it exceeds the observed balance of payments, then the province under consideration exports too much and we give its domestic final demand share more weight by increasing the value of d_i, at the expense of the other provinces. For the new list of shares, we recalculate the maximum overall domestic final use, etcetera. In the limit we obtain an optimal domestic final use that observes not only the consumption patterns in the provinces, but also their balances of payments. Basically, we thus find the optimum pattern of specialization between provinces, along with the supporting shadow prices of commodities and factor inputs. The execution of this program demands an enormous input-output database, comprising input statistics by sector and province for commodities, capital, and labor, stock statistics by province for capital and labor, and the latter broken down by skill. Appendix 2 outlines the data collection procedure. The data are made available by the authors upon request.

3. Competitive rewards

The factor inputs are capital plus four types of labor: technicians, managers, skilled, and unskilled workers. This order is assumed to constitute a top down hierarchy. In other

words, technicians are capable of fulfilling any of the labor tasks, managers can do their own job, skilled, or unskilled work, skilled workers can do their own job or perform unskilled work, and unskilled workers do their own job or are unemployed. We run two scenarios, which differ by the treatment of labor mobility.

In the first scenario we assume that workers prefer to stay put, climbing down the skill ladder rather than migrating, until they face unemployment. Formally, if l_1^i is the row vector of technicians coefficients in province i, l_2^i the same, but of managers, l_3^i of skilled labor, and l_4^i of unskilled labor, then the vector of outputs by sector in province i, x^i, is feasible with respect to the labor forces N_1^i, N_2^i, N_3^i, and N_4^i, if

$$l_1^i x^i \le N_1^i$$

$$\left(l_1^i + l_2^i\right) x^i \le N_1^i + N_2^i$$

$$\left(l_1^i + l_2^i + l_3^i\right) x^i \le N_1^i + N_2^i + N_3^i$$

$$\sum_{i=1}^{27} \left(l_1^i + l_2^i + l_3^i + l_4^i\right) x^i \le \sum_{i=1}^{27} \left(N_1^i + N_2^i + N_3^i + N_4^i\right)$$

The first inequality constrains demand for technicians. The second constraint can be rewritten as

$$l_2^i x^i \le N_2^i + (N_1^i - l_1^i x^i)$$

indicating that managerial demand is constrained by the sum of the labor force of managers and the number of redundant technicians. Similarly, the third constraint binds demand for skilled labor by the sum of the force of skilled workers and the numbers of technicians or managers for whom there are no jobs at the top 2 levels. The fourth and

last constraint is pooled over provinces. Only the sum of the total number of unskilled workers and the total number of higher skilled workers for whom there are no jobs at the top 3 levels in their own provinces, binds demand for unskilled labor.

The four constraints pick up shadow prices as the model determines the optimum allocation. The shadow price of the fourth constraint is the base wage. The shadow price of the third constraint is the skill premium. The shadow price of the second constraint is the managerial premium. The shadow price of the first constraint is the technician's premium. Technicians pick up shadow values from all four constraints and, therefore, the competitive wage of a technician will be the sum of the base wage and all three premiums. If, for example, the first constraint is not binding, meaning that there is excess supply of technicians, then the wage of a technician will be the base wage, plus the skill and managerial premiums, while the technician's premium is zero. In other words, the hierarchy of labor tasks' fulfillment guarantees that wages will increase by skill (or at least not decrease).

In the second scenario we allow for full labor mobility, summing not only the unskilled labor constraints over provinces, but also the skilled, managerial and technical labor constraints. Here the implicit assumption is that workers rather move to another province than accept a lower skilled job. By implication, not only the base wage, but also all premiums will be uniform across China. In other words, free mobility eliminates wage differentials between provinces.

We now present the results, in Table 1.

Table 1. Competitive factor rewards for the provinces (under limited mobility) and China (under full mobility)[3]

Province	Code	Base wage	Skilled wage	Managerial compensation	Technician's salary	Rent (%)	
						Limited	Full
Eastern							
Beijing	BJ	0	0	0	149085	0.11	2.26
Tianjin	TJ	0	0	86845	86845	0	1.47
Hebei	HB	0	3369	58792	58792	0.21	0.7
Liaoning	LN	0	0	0	95973	0.08	1.35
Shanghai	SH	0	0	125248	125248	0.43	2
Jiangsu	JS	0	0	36853	98241	0	1.1
Zhejiang	ZJ	0	3052	3052	92814	0.1	1.19
Fujian	FJ	0	6692	50130	50130	0.26	1.27
Shandong	SD	0	5911	57285	57285	0.12	1.08
Guangdong	GD	0	0	14534	152132	0.26	2.45
Middle							
Shanxi	SX	0	5402	5402	41729	0.13	0.51
Neimeng	NM						
Jilin	JL	0	4931	4931	39531	0.25	1.36
Heilongjiang	HLJ	0	0	52470	53867	0	1.43
Anhui	AH	0	4619	35839	35839	0.11	0.77
Jiangxi	JX	0	4807	4807	40256	0.15	0.88
Henan	HeN	0	4225	36607	36607	0.23	0.75
Hubei	HuB	0	846	846	40494	0.28	0.91
Hunan	HuN	0	5292	53682	53682	0.12	0.79
Western							
Guangxi	GX	0	5605	45914	45914	0.23	0.85
Hainan	HN						
Shichuan	SC	0	1226	1226	57502	0.21	0.58
Guizhou	GZ	0	8641	8641	34858	0.21	0.76
Yunnan	YN	0	6835	6835	20684	0.08	0
Tibet	TB						
Shaanxi	ShX	0	1779	1779	52916	0.14	0.61
Gansu	GS	0	5128	46837	46837	0.09	0.5
Qinghai	QH	0	4036	47978	47978	0.07	0.69
Ningxia	NX	0	2040	62649	62649	0.01	0.54
Xinjiang	XJ	0	9007	66330	66330	0	3.32
China		608	793	38278	38278		

Competition would have some dramatic effects. First and foremost, as the first column of Table 1 reveals for the provinces (under limited labor mobility), the competitive base wage is zero. The shortage of skilled labor in China would be a bottleneck if the economy were freely restructured along competitive lines. If, however, labor mobility were extended to all workers, then the bottleneck disappears and unskilled labor becomes short, picking up a substantial base wage. The pooling of all labor markets across provinces enlarges the feasible set quite a bit, which boosts total income further. Comparing the three income figures in Table 2 we conclude that Chinese domestic income is nearly 88% of its potential level, assuming limited mobility, or slightly over 60%, assuming full mobility.

While income grows steadily as markets are liberalized, the behavior of inequality is hill-shaped. Free markets would create serious inequality problems, but the problem is reduced in the transition from the first to the second scenario (when all labor markets become fluid across provinces), primarily because unskilled workers earnings rebound to positive values.

Table 2. China's income and Theil index[4]

	Income (billion Yuan)	Theil index
Observed	244	0.066
Limited mobility	316	0.617
Full mobility	395	0.392

Table 1 reflects the so-called dual variables of the program that maximizes the standard of living in China. The underlying primal variables, the sectoral output levels by province, specify the allocation itself and reveal the optimum pattern of specialization within China. The most extreme results are obtained in the second scenario where all

labor can freely flow between provinces. Table 3 provides the pattern. Agriculture remains active in a great number of provinces, but most other activities are best undertaken in specific provinces. Table 3 thus locates the comparative advantages of the Chinese provincial economies, revealing the threats and challenges they face. Most provinces best combine agriculture with some other industry or service. Only a few provinces have the potential to sustain a diversified economy under a perfectly competitive regime.

4. Labor migration

The competitive input-output model reallocates economic activity as to maximize the standard of living in China and this affects the level and mix of labor demand by province. The new demand for labor requires immigration, for unskilled labor in the first scenario, and for all types of labor in the second scenario. We depict all labor motions in Tables 4 and 5. Positive figures denote outflows and negative figures inflows. In Table 4 labor mobility is assumed to be limited to unskilled labor; changes in the use of other labor must be intra-provincial and, by our hierarchy assumption, reflect movements down the skill ladder. The first column shows the numbers of technicians kicked down to lesser skilled labor. All of them, however, can do the next best job, managerial labor, as the matching negative figures in the second column reveal. The positive figures in the second column represent managers who must do lesser work. In most cases they can perform skilled labor tasks, but in two provinces they are bumped further down the ladder. In Liaoning, the managers must accept unskilled work and in Beijing they must even go to another province or join the pool of the unemployed.

Table 3. Sectoral activity in provinces[5]

Sectors		Active provinces
Agriculture	1	BJ, TJ, HB, LN, JL, HLJ, SH, ZJ, FJ, JX, SD, HuB, HuN, GX, SC, YN, ShX, QH, NX
Coal mining & processing	2	SX
Petroleum & gas extraction	3	ShX
Metal mining & processing	4	SH
Non-metals mining & processing	5	HB
Food manufacturing	6	SH
Textile industry	7	FJ
Sewing & leather products	8	SH
Timer & furniture manufacturing	9	SH, AH
Paper making & stationary goods	10	AH
Electrical power steaming	11	JS
Petroleum processing	12	JX
Coking gas & coal products	13	GZ
Chemical industry	14	AH
Non-metals products	15	HB
Smelting & processing of metals	16	SX, ZJ
Metal products	17	HB
Machinery & equipment manufacturing	18	SD
Transportation equipment manufacturing	19	SD
Electric equipment & machinery	20	SD
Electronics & telecommunications equipments	21	AH, FJ
Instrument & meters	22	HuN
Other manufacturing	23	AH
Construction	24	HuN
Transportation & telecommunications	25	SH
Commerce	26	GX, XJ
Social service	27	HB, AH, HeN, GZ, GS
Culture, education & research	28	TJ, JS, GD
Banking & insurance	29	TJ
Public administration	30	All

Table 4. Limited Labor Mobility in Competitive Markets (outflows of workers)[6]

Province	Technicians	Managers	Skilled	Unskilled	Total	Unemployed	Migrants
Eastern							
BJ	0	44953	1279827	1378179	2702959	410002	2292956
TJ	9762	-9762	2002887	1642350	3645237	552933	3092303
HB	29223	-29223	0	-5830336	-5830336	0	-5830336
LN	0	347449	6964822	-16461870	-9149599	0	-9149599
SH	58931	-58931	143024	1038694	1181717	179251	1002467
JS	0	0	1454180	-5890230	-4436050	0	-4436050
ZJ	0	71015	-71015	-4986863	-4986863	0	-4986863
FJ	25413	-25413	0	-3896258	-3896258	0	-3896258
SD	31689	-31689	0	-2364354	-2364354	0	-2364354
GD	0	0	5373631	-10711608	-5337977	0	-5337977
Middle							
SX	0	42125	-42125	165904	165904	25165	140738
JL	0	37409	-37409	-3226722	-3226722	0	-3226722
HLJ	0	0	1354236	9082944	10437180	1583180	8854001
AH	104041	-104041	0	21928134	21928134	3326202	18601931
JX	0	36277	-36277	-2684545	-2684545	0	-2684545
HeN	76754	-76754	0	38110850	38110850	5780902	32329947
HuB	0	49173	-49173	-1505285	-1505285	0	-1505285
HuN	26545	-26545	0	-6451469	-6451469	0	-6451469
Western							
GX	47514	-47514	0	-2462967	-2462967	0	-2462967
SC	0	15302	-15302	-11973333	-11973333	0	-11973333
GZ	0	13257	-13257	-31970	-31970	0	-31970
YN	0	29884	-29884	-2068777	-2068777	0	-2068777
ShX	0	10365	-10365	-1768127	-1768127	0	-1768127
GS	19152	-19152	0	-3124099	-3124099	0	-3124099
QH	6030	-6030	0	-508408	-508408	0	-508408
NX	3088	-3088	0	1711862	1711862	259666	1452195
XJ	34982	-34982	0	4763098	4763098	722498	4040601
China	473124	224084	18267799	-6125207	12839800	12839800	71807140

Table 5. Full Labor Mobility in Competitive Markets (outflows of workers)[7]

Province	Technicians	Managers	Skilled	Unskilled	Total	Unemployed	Migrants
Eastern							
BJ	523316	-5541	1897325	-13405414	-10990313	0	-10990313
TJ	-2269299	-307334	1475014	666963	-434655	0	-434655
HB	391478	-333404	-4771198	16662626	11949502	0	11949502
LN	1462380	419809	6961669	-30395275	-21551417	0	-21551417
SH	-225255	-358654	-6958517	-2893130	-10435556	0	-10435556
JS	-3494421	17785	9994515	24727402	31245282	0	31245282
ZJ	849965	203448	3523130	-8926386	-4349843	0	-4349843
FJ	353451	-20805	-3497769	-2733534	-5898657	0	-5898657
SD	375766	-276158	-4631497	-22702952	-27234842	0	-27234842
GD	-4669089	-296916	8128426	20498257	23660678	0	23660678
Middle							
SX	284483	-80875	-3445017	9372636	6131227	0	6131227
JL	869289	197192	3245101	-9002456	-4690873	0	-4690873
HLJ	1077018	244081	4451721	-15966690	-10193870	0	-10193870
AH	-616148	-787779	-12990131	24618594	10224536	0	10224536
JX	781876	167559	2354644	-4001256	-697177	0	-697177
HeN	1341568	201972	3759760	37878917	43182217	0	43182217
HuB	1440151	292988	5096161	-17058434	-10229135	0	-10229135
HuN	-872369	-456036	-9909843	180852	-11057397	0	-11057397
Western							
GX	-340478	-753080	-12414881	4860314	-8648124	0	-8648124
SC	2205511	417382	7325684	-30582896	-20634319	0	-20634319
GZ	194290	-84439	-401935	13116773	12824689	0	12824689
YN	732736	139446	1977140	1362004	4211325	0	4211325
ShX	818941	183706	2134703	-6599557	-3462208	0	-3462208
GS	420123	81387	1086233	9754004	11341747	0	11341747
QH	139152	30596	426655	-1375541	-779138	0	-779138
NX	119322	20381	360031	-1853792	-1354057	0	-1354057
XJ	-311825	-438645	-5177126	3797972	-2129623	0	-2129623
China	1581934	-1581934	0	0	0	0	0

If we add all the mutations in the labor classes we get a positive or negative figure, depending on the province, and this translates in emigration or immigration, respectively. Since the net balance of labor demand mutations is positive, some workers are no longer needed and feed the pool of the unemployed. This figure is a modest 12.8 million. The composition of the labor force by skill is fairly stable. Few technicians and managers are bumped down, but many skilled workers must switch to unskilled labor.

In the second scenario all provincial labor demand mutations can be perceived as taking place through national markets, so in Table 5 the figures can be interpreted directly as inter-provincial movements. It is interesting to notice that the table is balanced, meaning that all workers find a job elsewhere. In particular, the demand for unskilled labor covers the unskilled labor force, in line with the positive wage we found for this scenario in section 3. The market of skilled labor is also balanced. Unlike the previous scenario, full labor mobility implies a shortage of managerial workers, albeit modest. Technicians, in line with Table 3 where they were shown to earn the same wage as managers, fill the gap.

So far we have limited our investigation of the efficient reallocation to labor. A final step is to include the dependants, to obtain people migration figures. The sequel paper provides so called dependency ratios. Applying these to the labor motions of Tables 4 and 5 we obtain the net emigration figures by province for the limited and the full labor mobility scenarios shown in Table 6. In either case the positive figures (denoting emigration) sum to the same total as the negative figures (denoting immigration). In the limited mobility scenario this figure is 125 million persons, while in the full mobility scenario it would shoot up to 269 million persons, suggesting that free markets would exercise an enormous pressure to move.

Table 6. Population Migration in Competitive Markets

Province	Scenario 1 (limited mobility)	Scenario 2 (full mobility)
Eastern		
Beijing	-3946928	18917928
Tianjin	-5472601	769230
Hebei	10122154	-20745751
Liaoning	15737055	37067837
Shanghai	-1707902	17779047
Jiangshu	7726473	-54421348
Zhejiang	8613648	7513344
Fujian	6828296	10337554
Shandong	4076624	46958374
Guangdong	9368830	-41527507
Emigration	62473080	139343314
Immigration	-11127431	-116694606
Net migration	51345649	22648708
Middle		
Shanxi	-246376	-10733316
Neimeng	0	0
Jilin	5599158	8139821
Heilongjiang	-15330430	17650372
Anhui	-32645366	-17943498
Jiangxi	4707699	1222591
Henan	-56602379	-75602234
Hubei	2630166	17873241
Hunan	11264635	19306848
Emigration	24201658	64192873
Immigration	-104824551	-104279048
Net migration	-80622893	-40086175
Western		
Guangxi	4315641	15153350
Hainan	0	0
Shichuan	20798476	35843184

Guizhou	56063	-22489351
Yunnan	3623650	-7376516
Tibet	0	0
Shaanxi	3094255	6058929
Gansu	5461197	-19826360
Qinghai	888714	1361959
Ningxia	-2567265	2393772
Xinjiang	-7122861	3754146
Emigration	38237996	64565340
Immigration	-9690126	-49692227
Net migration	28547870	14873113
China		
Emigration	124912734	268101527
Immigration	-125642108	-125642108
Overall errors	-729374	-2564354

Where would people go? It is handy to distinguish eastern from middle and western China. Referring to Table 1 for provincial codes and to Figure 1 for a map, Eastern China consists of Shanghai, Beijing, Tianjin, Guangdong, Zhejiang, Liaoning, Jiangsu, Fujian, Hebei, Shandong, Middle China of Heilongjian, Jilin, Shanxi, Neimeng, Jiangxi, Hunan, Hubei, Anhui, Henan, and Western China of Hainan, Xinjiang, Tibet, Qinghai, Ningxia, Guangxi, Shaanxi, Yunnan, Sichuan, Gansu, and Guizhou. We will now discuss the pattern of migration in either scenario.

When labor mobility is limited (scenario 1) redundant technicians substitute for managers in the thirteen provinces of Tianjin, Hebei, Shanghai, Anhui, Fujian, Shandong, Henan, Hunan, Guangxi, Gansu, Qinghai, Ningxia, and Xinjiang. In the provinces of Beijing, Shanxi, Liaoning, Jilin, Zhejiang, Jiangxi, Hubei, Shichuan, Guizhou, Yunnan, and Shaanxi, redundant managers substitute for skilled labor. In the

provinces of Beijing, Tianjin, Liaoning, Heilongjiang, Shanghai, Jiangshu, and Guangdong, some skilled labor is redundant, and substitute for unskilled labor. In total, the provinces of Beijing, Tianjin, Shanxi, Heilongjiang, Shanghai, Anhui, Henan, Ningxia, and Xinjiang have emigration, while other provinces face immigration. The difference between redundancy and migration reflects the unemployment.

When labor mobility is full (scenario 2), Table 5 shows the situation of labor substitution and migration in all provinces. In the nineteen provinces of Beijing, Hebei, Shanxi, Liaoning, Jilin, Heilongjiang, Zhejiang, Fujian, Jiangxi, Shandong, Henan, Hubei, Shichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, and Ningxia, redundant technicians substitute for managers or migrate out. In the provinces of Liaoning, Jilin, Heilongjiang, Jiangsu, Zhejiang, Jiangxi, Henan, Hubei, Shichuan, Yunnan, Shaanxi, Gansu, Qinghai, and Ningxia, redundant managers substitute for skilled labor or migrate out. In the provinces of Beijing, Tianjin, Liaoning, Jilin, Heilongjiang, Jiangshu, Zhejiang, Jiangxi, Henan, Hubei, Guangdong, Shichuan, Yunnan, Shaanxi, Gansu, Qinghai, and Ningxia, some skilled labor is redundant, and substitute for unskilled labor or migrate out. In total, the provinces of Beijing, Tianjin, Liaoning, Jilin, Heilongjiang, Shanghai, Zhejiang, Fujian, Jiangxi, Shandong, Hubei, Hunan, Guangxi, Shichuan, Shaanxi, Qinghai, Ningxia, and Xinjiang have immigration, while other provinces face emigration.

For many decades, the Chinese government has conducted a special system of residence registration, the so-called "Hukou". The economic reform has weakened the action of the "Hukou", giving more freedom to the labor markets. Labor moves under the incentive to survive or to improve the standard of living. Currently, the mobility of labor, particularly farmers, is steadily increasing. In current years there have been tens of millions of farmers moving around the country to search a work. Wang et al (1995)

estimate that, at that time, China have in fact 130 million surplus farmers, and that this number will increase to 230 million in the next ten years.

In scenario 1, over 70 million unskilled laborers will migrate, as the figure on national migration shows in Table 4. In scenario 2, over 15 million laborers will migrate, as the national redundancy figure shows in Table 5. Table 6 shows that national-wide migrants that is including with the family members,[8] will be about 125 and 270 million in two scenarios, respectively. Under scenario 1, in the eastern part, Beijing, Tianjin and Shanghai, the three most developed provinces in China, will absorb 11 million migrants, while the other seven provinces will export 62 million migrants. Overall, the eastern will export 51 million migrants. In the middle part, Shanxi, Heilongjiang, Anhui, and Henan will attract nearly 105 million, among which 24 million come from the other provinces in the part and 81 million from eastern and western parts. In the western part, only Ningxia and Xingjiang will host about 10 million migrants, the majority of the migrants will leave the part.

Under scenario 2, in the eastern part, Hebei, Jiangsu, and Guangdong, will absorb 117 million migrants, while the other seven provinces will export 139 million migrants. Overall, the eastern part will export 22 million migrants. In the middle part, Shanxi, Anhui, and Henan will attract 104 million migrants, among which 64 million come from the other provinces in the part and 40 million from eastern and western parts. In the western part, Guizhou, Yunnan and Gansu will host 50 million migrants, while the other provinces will export 65 million migrants, 15 million of which will leave the part.

Because Neimeng, Hainan and Tibet do not participate in the competitive market, their populations will remain constant in this research.

5. Conclusion

Perfect competition would restructure the Chinese economy severely. If factor inputs were rewarded according to their provincial or national scarcities, unskilled labor would stand to lose and, therefore, inequality would mount. The pressure on interprovincial migration would be enormous with 10 to 20% of the people on the road. The flipside is the great potential for improvement of the average standard of living. Optimal specialization between provinces alone (without changing technology or the trade position), may add one half to the level of domestic final consumption in China.

Appendix 1. The general equilibrium model

The objective function is scalar *D*, the overall value of national final uses, the sum of the values of final uses in all sectors and all provinces:

$$Max \quad D$$

Denote the exogenous variables to the linear program as follows:

A^i a square matrix of intermediate input coefficients, 30 by 30, of province *i*

f^i a 30-dimensional column vector of the proportions of province *i*'s final uses

e^i a 30-dimensional column vector of province *i*'s net foreign exports

d^i a scalar of province *i*'s overall final uses in domestic final uses

The endogenous variables are:

x^i a column vector of province *i*'s 30 outputs (nonnegative)

D a scalar of overall domestic final uses

The first constraints are the material balances:

$$\sum_{i=1}^{27}\left(I-A^i\right)x^i \geq \sum_{i=1}^{27} f^i d^i D + \sum_{i=1}^{27} e^i$$

Notice that the material balances are pooled across provinces, meaning that the commodities are assumed to be tradable. There is one exception. The last commodity, public administration, is non-tradable, warranting separate constraints:

$$x_{30}^i - \sum_{j=1}^{30} a_{30,j}^i x_j^i \geq f_{30}^i d^i D, \quad i=1,\cdots,27.$$

The labor constraints have been described in section 3. In addition, there are 30 capital constraints, presuming that capital is sector specific, but mobile across provinces.

$$\sum_{i=1}^{27} K^i x^i \leq m.$$

where K^i is a diagonal matrix of input coefficients of fixed capital in province *i*, 30 by 30, and *m* a 30-dimensional column vector of endowments of fixed capital.

For each vector of provincial shares of domestic final demand, *d*, the linear program determines an optimal allocation of gross outputs and shadow prices. Denoting *p* as the shadow prices of commodities, $S^i(d)$ as the overall value of net exports to the rest of China in province *i*, and S_o^i as the observed value of net exports to the rest of China in province *i*, the overall value of the net exports in each province is:

$$S^i(d) = p\left[\left(I-A^i\right)x^i - f^i d^i D - e^i\right], \quad i=1,\cdots,27.$$

The equilibrium provincial shares will be determined by the condition that the provincial values of net exports to the rest of China match the observed trade surplus:

$$S^i(d) = S_o^i, \quad i=1,\cdots,27.$$

The solution to this non-linear equation, d^*, is obtained by interactively solving the linear program and applying the Newton algorithm,

$$d^i_{n+1} = \frac{\left[S^i(d_n) - S^i_o\right] d^i_{n-1} - \left[S^i(d_{n-1}) - S^i_o\right] d^i_n}{S^i(d_n) - S^i(d_{n-1})}$$

Appendix 2. The data for the general equilibrium model

National and provincial input-output tables

Most Chinese provinces have produced square input-output tables in three versions, with 6, 33, and 118 commodities. We consolidate the 33 sectors table into one with 30 sectors by aggregating maintenance, repair and other industries, commerce and restaurants, and freight and passenger transports. The tables provide intermediate inputs, value added, domestic final use, some interprovincial and international trade, and gross outputs. The main problem is that to pinpoint the provincial final consumption vectors, we must determine their exports to not only the rest of the world, but also to the rest of China.

Twelve provinces provide separate information on interprovincial and international trade. Their exports to the rest of China sum to 829,782 million Yuan, their imports to 898,960 million Yuan, hence their domestic net exports amount to -69,178 million Yuan. Net domestic exports in the 15 provinces without separate information on interprovincial and international trade must therefore be 69,178 million Yuan. We assume that the ratio of overall exports (829,782 million Yuan) to gross output (3,766,102 million Yuan) in the 12 provinces, which is 0.22, equals the ratio of overall import (58,596 million Yuan) to gross output (2,663,441 million Yuan) in the 15 provinces. Then overall import from the rest of China in the 15 provinces is 585,957 million Yuan (and the overall export is 585,957 + 69,178 = 655,135 million Yuan). The

overall export is allocated to the 30 sectors by their shares of net exports. The material balances then determine the imports from the rest of China.

The trade data need to be further separated in the 15 provinces. We calculate their shares in exports to the rest of China or the world and assume that these match the shares of exports to the rest of China. This procedure disaggregates exports to the rest of China by origin. The same procedure is applied to the imports from the rest of China.

Domestic trade in the 15 provinces is disaggregated by sector by means of the RAS method.[9] For 15 provinces the exports are not separated between domestic and foreign. The Newton algorithm (see Appendix 1) requires separation though. For this purpose we have constructed a commodity by province table. Column 28, which is the sum of columns 1-27, shows the overall exports at the sectoral level, whereas row 31, which is the sum of rows 1-30, indicates the overall exports at the provincial level. Columns 1-28 and rows 1-31 are the original data, while column 29 and row 32 are the data estimated above. The former are the overall exports to the rest of China at the sectoral level; the latter are the overall exports to the rest of China at the provincial level. The data in columns 1-27 and rows 1-30 need to be adjusted such that the sum of columns 1-27 equals column 29, and the sum of rows 1-30 equals row 32 by the RAS method. The same procedure is also applied to the import from the rest of China. Once the exports to and the imports from the rest of China are separated, the exports to and the imports from the rest of the world can be obtained by extracting the exports to and the imports from the rest of China from the total mixture of exports and imports.

Capital stocks

The State Statistical Bureau has made available to us the unpublished data on capital stocks in the year 1992 for 40 industrial sectors by province. We aggregate these data

into 23 industrial sectors according to the sector classifications in the input-output table. The data for non-industrial sectors are estimated from the information on investment in the China Statistical Yearbook (1993).[10] Here the classification is as follows: (1) agriculture, (2) industry, (3) geological prospecting, (4) construction, (5) transportation and telecommunications, (6) commerce, food services and storage, (7) real estate and public services, (8) health care, sports and social welfare, (9) education and culture, (10) scientific research, (11) banking and insurance, (12) administration, (13) others. Sectors (3)-(13) are simply aggregated into seven non-industrial sectors. We calculate the proportions of the investment in industry to the investment in these non-industrial sectors and use these for the proportions of capital stocks. This determines the capital stocks in the non-industrial sectors. The data on the capital stocks in the agricultural sectors are obtained in a different way. The Rural Statistical Yearbook of China in 1993[11] provides data on the number of rural households by province and on the capital stocks per rural household; the two sources are used to derive the capital stocks in the agricultural sector by province.

Employment and labor resources

Information on employment and labor resources is obtained from the provincial "Population Census in 1990." The original data in each province for employment and labor are broken down into 55 sectors and eight types of occupation; we aggregate them into 30 sectors and four types of occupations.

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[1] We miss Neimeng, Hainan, and Tibet because of data problems. Fortunately, these are small provinces.

[2] The map is from http://www.chinatour.com/map/a.htm.

[3] The province rows show the competitive wages (in Yuans) when labor mobility is limited to the unskilled. The last two entries, on the extreme right hand side show the competitive rental rates (in percentages) in the same scenario, as well as in the full mobility scenario, respectively. In the full mobility scenario all wages are uniform across China, as depicted in the China row.

[4] The objective function, domestic final use, has an observed value, and two optimal values, corresponding to the two scenarios; the Theil's indices summarizing their distributions are described in the sequel paper.

[5] See Table 1 for province codes.

[6] See Table 1 for province codes. The first four columns are outflows from employment. The sum is given in the fifth column. If negative, there must be immigration, as the last column confirms. If positive, the figure is divided between emigrants (positive entries in the last column) and unemployed (next to last column). Strictly speaking the model cannot predict the distribution of the unemployed by province; we simply assume a uniform division of excess workers between emigrants and unemployed.

[7] See note 6. In this scenario all employment reductions are absorbed by emigration.

[8] The family members are accounted for based on the dependency ratios in each province, which are presented in appendix 2.

[9] For a detailed introduction to the RAS method, see Bacharach (1970).

[10] See Tables 5-23 "Investment in Capital Construction by Sector of National Economy and Province in 1992" and 5-43 "Investment in Technical Updating and Transformation by Sector of National Economy and Province in 1992."

[11] See Table 4-3 "Rural Households and Population by Province in 1992" for the data on the number of rural households by province, and Table 3-24 "Original Value of Fixed Assets for Production Per Rural Household by Province" for the information on capital stocks per rural household.